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NAVFAC **IGS-15181 (OCTOBER 2002)**

Preparing Activity: LANTNAVFACENGCOM **Based on UFGS-15181N**

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

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SECTION 15181

CHILLED, CONDENSER, OR DUAL SERVICE WATER PIPING
10/02

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NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

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NOTE: This guide specification covers requirements for chilled water, condenser water, and hot and cold water (dual service) piping systems inside of buildings, or leading from equipment adjacent to buildings. Project requirements may require addition of supplemental information to paragraphs contained herein.

Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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NOTE: Refrigerant piping is now covered by Section 15182, "Refrigerant Piping."

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PART 1 GENERAL

1.1 REFERENCES

Publications listed below form a part of this specification to the extent referenced. Publications are referred to in the text by the basic

designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1996) Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

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NOTE: A UNI Norm is a technical normative recognized as Italian Law, submitted by a private organization "Ente Nazionale Italiano di Unificazione" for Italy and is available only in the Italian language. It is the National Standard.

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UNI 663	(1968) Unalloyed steel seamless tubes - Plain end tubes for general purposes - Qualities, requirements and tests
UNI 1282	(1982) Pipe components - Series of nominal sizes
UNI 1288	(1974) Unalloyed steel screwed seamless tubes for water well, with coupling - Light series tubes
UNI 2227	(1967) Metallic pipe flanges - Dimensions of tongued and groove facings for round section gaskets - Nominal pressures 10 to 40
UNI 2249	(1967) Metallic pipe flanges - Circular screwed flanges - Nominal pressure 1
UNI 2250	(1967) Metallic pipe flanges - Circular screwed flanges - Nominal pressure 2,5
UNI 2253	(1967) Metallic pipe flanges - Circular screwed flanges - Nominal pressure 6
UNI 3564	(1965) Corrosion of metallic materials - Environments and factors of atmospheric corrosion

UNI 5596	(1965) Thin square nuts - ISO metric coarse thread - Finish A
UNI 6918	(1971) Classification and performance qualification of welders - Welders of pipes of whatever material employing different procedures for the first pass and filling passes
UNI 7125/FA 109	(1972/82) Flanged gate valves for water pipelines - Technical conditions of delivery
UNI 7151	(1972) Pipe clamps for use on board ships - Half collars, brackets and supports for flat bar clamps with expansion joint
UNI 7177	(1973) Elastomers: Products - Sealing rubber gaskets for cooling circuits and chambers of the railway diesel locomotives and diesel railcars - Qualities, requirements and tests
UNI 7182	(1973) Steel formed heads for welded pressure vessels and boiler drums - With centre manhole type
UNI 7183	(1973) Steel formed heads for welded pressure vessels and boiler drums - With eccentric manhole type
UNI 7543-1	(1988) Safety colours and safety signs - General instructions
UNI 7672	(1977) Butt welded joints in ferrous metal and nickel alloys - Longitudinal face and root bend test
UNI 7676	(1977) Unalloyed steel spiral ropes - Strands with 7 wires for prestressed concrete
UNI 7773-1	(1981) Seamless copper tubes for general purpose - Qualities, requirements and tests
UNI 8364/FA 146	(1984/84) Heating plants - Inspection and maintenance
UNI 8858	(1985) Copper alloy ball valves for heating plants - Requirements and tests
UNI 9157	(1988) Water supply - Back flow preventer - Characteristics and tests

UNI 9182	(1987) Water supply and distribution - Drainage system and storm water system
UNI 9497	(1989) Technical prescriptions for electrical servo controls employed for valves working
UNI 9753	(1990) Technical rules for control valves of hot water heating plants
UNI 9760-1	(1990) Nuclear plants - Supports, attachments and anchors for piping - Nomenclature and definitions
UNI 9765	(1991) Pressure and vacuum gauges with bellows elastic element - Construction characteristics
UNI 10582	(1996) Rubber products - Rubber vulcanized seals for connection flexible hoses of domestic gas appliances - Requirements

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN) (UNI ENV) (CEI EN) (UNI EN ISO)(UNI ISO)

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NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.

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UNI ISO 7-1	(1984) Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation
UNI EN 175	(1999) Personal protection - Equipment for eye and face protection during welding and allied processes
UNI EN 255-3	(1998) Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 3: Testing and requirements for marking for sanitary hot water units
UNI EN 331	(1998) Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings

UNI EN 545	(1995) Ductile iron, pipes, fittings, accessories and their joints for water pipelines - Requirements and test methods
UNI EN 809	(2000) Pumps and pump units for liquids - Common safety requirements
UNI EN 1074-3	(2001) Valves for water supply - Fitness for purpose requirements and appropriate verification tests - Part 3: Check valves
UNI EN 1092-2	(1999) Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 2: Cast iron flanges
UNI EN 1254-1	(1998) Copper and copper alloys - Plumbing fittings - Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes
UNI EN 1254-2	(1998) Copper and copper alloys - Plumbing fittings - Part 2: Fittings with compression ends for use with copper tubes
UNI EN 1254-3	(1998) Copper and copper alloys - Plumbing fittings - Part 3: Fittings with compression ends for use with plastic pipes
UNI EN 1254-4/AC	(1998/99) Copper and copper alloys - Plumbing fittings - Part 4: Fittings combining other end connections with capillary or compression ends
UNI EN 1254-5	(1998) Copper and copper alloys - Plumbing fittings - Part 5: Fittings with short ends for capillary brazing to copper tubes
UNI EN ISO 1460	(1997) Metallic coatings - Hot dip galvanized coatings on ferrous materials - Gravimetric determination of the mass per unit area
UNI EN ISO 1461	(1999) Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
UNI EN 1514-4	(1998) Flanges and their joints - Dimensions of gaskets for PN-designated flanges - Part 4: Corrugated, flat or grooved metallic and filled metallic gaskets for use with steel flanges
UNI ENV 1805-1	(1998) Data Communication for HVAC

	Application Management Net - Part 1: Building Automation and Control Networking (BACnet)
UNI EN ISO 3677	(1996) Filler metal for soft soldering, brazing and braze welding - Designation
UNI ISO 4145	(1984) Non-alloy steel fittings threaded to ISO 7/1
UNI EN ISO 5167-1/A1	(1997/2000) Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full
UNI ISO 5251	(1982) Stainless steel butt-welding fittings
UNI EN ISO 5252	(1991) Steel tubes - tolerance systems
UNI ISO 5781	(1990) Hydraulic fluid power - Pressure-reducing valve, unloading valves, throttle valves and check valves - Mounting surfaces
UNI ISO 9227	(1993) Corrosion test in artificial atmospheres - Salt spray tests
UNI EN 10242	(2001) Threaded pipe fitting in malleable cast iron
UNI EN 12760	(1999) Valves - Socket welding ends for steel valves
UNI EN ISO 10564	(1999) Soldering and brazing materials - Methods for the sampling of soft solders for analysis
UNI ENV 22605-1	(1992) Steel products for pressure purposes - Derivation and verification of elevated temperature properties - Yield or proof stress of carbon and low alloy steel products
UNI EN 29453	(1996) Soft solder alloys - Chemical composition ad forms
CEI EN 60034-1	(2000) Rotating electrical machines - Part 1: Rating and performance
CEI EN 60529/A1	(1997/00) Degrees of protection provided by enclosures (IP Code)

CEI EN 60947-4-1	(2000) Low-voltage switchgear and controlgear - Part 4: Contactors and motor-starters - Section 1 - Electromechanical contactors and motor-starters

1.2 GENERAL REQUIREMENTS

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NOTE: The following information shall be shown on the project drawings:

1. Single line plan and necessary sections indicating location, sizes, and routing of associated piping.

2. Flow and generic control diagrams for system(s).

3. Appropriate schedules and details for equipment or components.

Designer should consider cathodic protection for buried piping. When necessary, include herein or in another section as required by the specific design to protect piping for desired life of system. Waterproof non-corrosive (non-metallic) conduit is a recommended alternative.

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Section 15050, "Basic Mechanical Materials and Methods," applies to this section with additions and modifications specified herein.

1.2.1 Description of Work

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NOTE: Edit as necessary.

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Work shall include furnishing, installing, and testing of [chilled] [condenser] [hot and cold (dual service)] water piping system, as indicated, together with piping, tubing, flanges, bolting, gaskets, valves, fittings, pressure containing assemblies, flow measuring equipment, flow control equipment, circulating pumps, and associated appurtenances necessary for a complete and operable system. [Work also includes [modifications] [and] [connections] to existing [chilled] [condenser] [hot and cold (dual service)] water system(s).]

1.2.2 Associated Work

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NOTE: Edit, specifying associated sections for specific project.

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[Other work associated with this section including controls, insulation, exterior water distribution system(s), chillers, cooling towers, boilers, heat exchangers, water treatment chemicals and equipment, anti-freeze solutions and equipment, and painting is covered in other sections of this specification.]

1.2.3 System Design Temperatures, Pressures, and Classes

System design pressures shall not be less than 1.5 times system maximum operating pressure at design temperature. Piping components shall be suitable for use under design pressures specified. Except as modified herein, pressure/temperature limitations shall be as specified in referenced standards and specifications. Pressures in this specification are pressures in kiloPascal (kPa) above atmospheric pressure, and temperatures are in degrees Centigrade (C). System design, component selection, and system installation, including pressure containing parts and materials, shall meet or exceed the following requirements:

[a. [Chilled] [and] [Condenser] water piping shall be designed for a minimum service pressure of 862 kPa at 66 degrees C; minimum ANSI Class 125.]

[b. Hot and cold (dual service) water piping shall be designed for a minimum service pressure of 1034 kPa at 121 degrees C; minimum ANSI Class 150.]

1.3 SUBMITTALS

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NOTE: For projects in Italy, Spain, and Greece, except for Aviano Air Base, Aviano, Italy, the Quality Control Manager is not authorized to approve submittals. Therefore, the EFA MED Specifications do not contain "G's". For these projects utilize special sections NFGS-E-01330, "Submittal Procedures" and NFGS-E-01450, "Quality Control."

For projects at Aviano Air Base, Aviano, Italy, the Quality Control Manager is authorized to approve submittals. On these projects, add a "G" within submittal tags for each submittal item deemed sufficiently critical, complex, or aesthetically significant to merit approval by the Government. When "G's" are used on any submittal item, utilize standard sections NFGS-01330, "Submittal Procedures" and NFGS-01450, "Quality Control."

Where a "G" follows a submittal item, it indicates that the submittal item requires Contracting Officer's approval. Submittal items not designated with a "G" will be approved by the QC organization.

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Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Water piping, fittings, and accessories

Gaskets

Soldering [and brazing] metals

Valves

Pump motors

Instrumentation

Pipe hangers and supports

Pumps

Motor starters

Tanks

Pipe cleaning chemical

For valves, submit valve manufacturer's published ratings and maximum operating pressure differential. For relief valves, also submit manufacturer's published discharge capacity ratings. For pumps, include pump speed and characteristic curves for performance of impeller selected for each pump. Curves shall indicate capacity versus head, efficiency, and brake horsepower for full range, from shutoff to free delivery. Provide family of curves for each pump volute size indicating multiple impellers and operation points. Computer operating curve characteristics are not acceptable.

SD-07 Certificates

Welding procedure

Performance qualification record

List of welders' names and symbols

Backflow preventer certificate

SD-08 Manufacturer's Instructions

Pumps

Tanks

SD-10 Operation and Maintenance Data

Pumps, Data Package 3

Flow measuring equipment, Data Package 2

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

SD-11 Closeout Submittals

Posted operating instructions

1.4 QUALITY ASSURANCE

1.4.1 Defective Welds

Give welders making defective welds, after passing a qualification test, a requalification test. Welders failing requalification test shall not be permitted to work under this contract.

1.4.2 Previous Welder Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without requalifying subject to approval of the Contracting Officer and provided that conditions specified in UNI 6918 are met before a procedure is used.

1.4.3 Welding Procedure

Before performing welding, the Contractor shall submit to the Contracting Officer three copies of welding procedure specification for each metal included in the work, together with proof of qualifications in accordance with UNI 6918.

1.4.4 Performance Qualification Record

Before performing welding, the Contractor shall also submit to the Contracting Officer three copies of the Welder's Performance Qualification Record in conformance with UNI 6918 showing that the welder or operator was tested under the approved procedure specification submitted by the Contractor. Certification dates shall be less than one (1) year old.

1.4.5 List of Welders' Names and Symbols

Submit the assigned number, letter, or symbol used to identify the work of the welder, and affix it immediately upon completion of the weld.

1.4.6 Backflow Preventer Certificate

Submit for each design, size, and make of backflow preventer being provided for the project. Certificate shall be from the Foundation for Cross-Connection Control Research, University of Southern California, and shall attest that this design, size and make of backflow preventer has

satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. A Certificate of Provisional Approval will not be acceptable in lieu of the above.

1.4.7 Posted Operating Instructions

Submit posted operating instructions for flow measuring equipment, piping system diagrams and codes.

1.5 SPECIMENS, CORROSION PREVENTION OF FERROUS METALS

Expose for 125 hours in a salt-spray fog test, except equipment located outdoors shall withstand 500 hours. Salt-spray fog test shall be in accordance with UNI ISO 9227 using a 5 parts by weight (plus or minus 1) of sodium chloride in 95 parts of distilled water or water containing not more than 200 parts per million of total solid sodium chloride solution. Immediately after completion of test, coating shall show no signs of blistering, wrinkling, or cracking, no loss of adhesion, and specimen shall show no signs of rust creepage beyond 3 mm on either side of scratch mark. Each specimen shall have a standard scratch as defined in UNI 3564. Film thickness of factory coating or paint system applied on equipment shall not be less than film thickness used as test specimen.

1.6 SAFETY PRECAUTIONS

1.6.1 Rotating Equipment Safety

Fully guard couplings, motor shafts, gears and other exposed rotating or rapidly moving parts in accordance with UNI 8364/FA 146. Guards shall be cast iron or expanded metal. Guard parts shall be rigid, secured, and readily removable without disassembling guarded unit.

1.6.2 Welding and Cutting Safety

UNI EN 175.

PART 2 PRODUCTS

2.1 SOURCE MANUFACTURERS

2.1.1 Water Piping, Fittings, and Accessories

The following manufacturers provide water piping materials, fittings, flanges, unions, end connections and other accessory components that generally comply with these specifications:

DALMINE
Piazza Caduti 6 Luglio 1944, 1
24044 Dalmine (BG) Italy
Tel: 035560.1111
Fax: 0355603827

ARVEDI TUBI ACCIAIO
Zona Porto Canale

26100 Cremona
Tel: 0372/4091
Fax: 0372/413170
www.arvedi.it

TIEMME RACCORDERIE S.p.A.
via Cavallera 6/A
25045 Castegnato (BS)
Tel: 030/2142211
Fax: 030/2142206
www.tiemme.com

GIACOMINI S.p.A.
Via per Alzo, 39
28017 San Maurizio D'Opaglio (NO)
Tel: 0322/923111
Fax: 0322/96256
www.giacomini.com

CAST
Strada Brandizzo 406/408
10088 Volpiano (TO)
Tel: 011/9827011
Fax: 011/98270225
www.cast.it

PASOTTI EXPORT srl - AIGNEP
Via V. Montini 122
25067 Lumezzane (BS)
Tel: 030/8259526
Fax: 030/829651
www.pasotti.it

2.1.2 Valves

The following manufacturers provide water piping valves and related equipment that generally comply with these specifications:

VALVOTUBI IND S.r.l.
via M. Monti, 30/B
48100 Ravenna - Italy
Tel: 544/542279
Fax: 544/541148

FAR RUBINETTERIE S.p.A.
Via Morena, 20
28024 Gozzano (NO)
Tel: 0322/94722
Fax: 0322/955332
www.far-spa.it

ISI INDUSTRIA SARACINESCHE IDRAULICHE
Via L. Galvani, 6
38015 Lavis (TN)

Tel: 0461/248311
Fax: 0461/247024
www.tubighisa.com

2.1.3 Miscellaneous Components

The following manufacturers provide miscellaneous components for piping systems that generally comply with these specifications:

LA POLITERMICA
Via Macello, 51
39100 Bolzano
Tel: 0471/971430
Fax: 0471/981127
www.vetribagno.com

GRINNELL SALES & DISTRIBUTION
Via San Giacomo, 260
39055 Laives (BZ)
Tel: 0471/252091
Fax: 0471/254058

2.1.4 Pumps

The following manufacturers provide water system pumps that generally comply with these specifications:

SALMSON ITALIA
Via Jacopo Peri, 80
41100 Modena
Tel: 059/280380
Fax: 059/282331

FINDER POMPE S.p.A.
Via Bergamo, 65
22055 Merate - Italy
Tel: 39/9907121
Fax: 39/599267

WILO ITALIA S.r.l.
Via I Maggio, no. 6/bis
20068 Peschiero Borromeo (MI)
Tel: 02/5538351
www.wilo.it

MAJMAR s.r.l.
Via Apelle 43
20128 Milano - Italy
Tel: 02/2550301
Fax: 02/2553020

KSB ITALIA S.p.A.
Via Le Tunisia, 46
20124 Milano, Italy

Tel: 02/62.74
Fax: 02/66983272

2.1.5 Tanks

The following manufacturers provide expansion tanks and air separation tanks that generally comply with these specifications:

CIMM S.r.l
Via Caprera, 13
31030 Castello di Godego (TV)
Tel: 0423/760009
Fax: 0423/760041
www.cimmsrl.com

RIELLO S.p.A.
37045 Legnago (VR)
Tel: 0442.630111
Fax: 0442.22378
www.riello.it

2.1.6 Expansion Joints

The following manufacturers provide expansion joint components for water systems that generally comply with these specifications:

BRANDONI S.p.A.
Via Novara, 199
28078 Romagnano Sesia (NO)
Tel: 0163/828111
Fax: 0163/834458
www.brandoni.com

T.F. PIPING
Via Anicio Paolino, 6
00178 Roma - Italy
Tel: 06/7809997
Fax: 06/7801719
www.tfpiping.com

2.1.7 Backflow Preventers

The following manufacturers provide water system backflow preventers that generally comply with these specifications:

BRANDONI S.p.A.
Via Novara, 199
28078 Romagnano Sesia (NO)
Tel: 0163/828111
Fax: 0163/834458
www.brandoni.com

T.F. PIPING
Via Anicio Paolino, 6

00178 Roma - Italy
Tel: 06/7809997
Fax: 06/7801719
www.tfpiping.com

2.2 WATER PIPING, FITTINGS, AND ACCESSORIES

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NOTE: When service permits use of copper piping and an option exists, specify either Type "K" or "L" depending upon service and design pressure and temperature. Type "M" copper should only be specified for drain piping.

Designer should consider cathodic protection for buried piping. When necessary, include herein or in another section as required by the specific design to protect piping for desired life of system. Waterproof non-corrosive (non-metallic) conduit is a recommended alternative.

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Piping systems as used in this paragraph include chilled water and hot water piping systems. Piping systems shall be compatible with system fluids, and capable of the pressures and temperatures indicated on the drawings and shown in the specifications. Provide increasers where flanges and equipment connections are less than full line size. Piping systems shall conform to UNI EN ISO 5252.

2.2.1 Chilled Water Piping

Provide [butt welded] [electric-resistance welded] [seamless] Schedule 40 black steel pipe conforming to UNI 663, UNI 1282, UNI 1288. Piping 100 mm and smaller may be hard drawn copper tubing; [Type K for underground piping] [and] [Type [_____] for other aboveground use] conforming to UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5.

2.2.2 Condenser Water Piping

Provide [butt welded] [electric-resistance welded] [seamless] Schedule 40 black steel pipe conforming to UNI 663, UNI 1282, and UNI 1288 [or] [copper tubing conforming toUNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5, hard drawn].

2.2.3 Hot and Cold Water (Dual Service) Piping

Provide [butt welded] [electric-resistance welded] [seamless] Schedule 40 black steel pipe conforming to UNI 663, UNI 1282, and UNI 1288, [or] [copper tubing conforming to UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5, hard drawn].

2.2.4 Fittings and Flanges for Steel Piping

2.2.4.1 Sizes 3 to 50 Millimeters

Steel fittings, UNI EN 12760, socket welding type; malleable iron fittings, UNI ISO 4145, threaded type.

2.2.4.2 Sizes 65 Millimeters and Above

Steel fittings, UNI ISO 5251, butt-welding type, or UNI 2249, UNI 2250, and UNI 2253, flanged type, or convoluted steel flanges conforming to UNI 7182, and UNI 7183; cast iron fittings, UNI EN 1092-2, flanged type; bronze fittings up to 200 mm size, flanged type.

2.2.5 Fittings for Copper Tubing

Fittings for copper tubing shall be cast copper alloy solder-joint type conforming to UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5, or wrought copper solder-joint type conforming to UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5.

2.2.6 Unions

2.2.6.1 Unions (Threaded) for Steel Pipe

UNI EN 10242.

2.2.6.2 Unions for Copper Tubing

UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5; solder-joint end type.

2.2.6.3 Dielectric Union

Provide insulated union of galvanized steel and female threaded on end. Solder joints conforming to UNI EN 10242, dimensional strength and pressure requirements. Union shall have water impervious insulation barrier capable of limiting galvanic current to one percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test.

2.2.7 End Connections

2.2.7.1 Steel Piping

50 mm and smaller shall be threaded or socket welded; 65 mm and larger shall be flanged or butt welded.

a. Threaded joints: Thread in accordance with UNI ISO 7-1.

b. Flanged joints:

(1) Bolting of flanges: Material used for bolts and studs shall conform to UNI ENV 22605-1, and material for nuts shall conform to UNI ENV 22605-1. Dimensions of bolts, studs, and nuts shall conform to UNI 5596, with threads conforming to manufacturer instructions, coarse type with fit for bolts and studs, and fit

for nuts. Bolts or studs shall extend through nuts and may have reduced shanks of a diameter not less than diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy, semifinished hexagonal nuts.

(2) Gaskets: UNI 7177 and UNI 10582, fluorinated elastomers, suitable for pressure and temperature ranges encountered, and compatible with grooves in flange faces. Dimensions for nonmetallic gaskets shall conform to UNI 2227.

c. Butt weld joints: UNI 7672. Use of backing rings shall conform to UNI 7676. Ferrous rings shall be of good weldable quality and not exceed 0.05 percent sulfur; for alloy pipe, backing rings shall be of material compatible with chemical composition of parts to be welded and preferably of same composition. Backing rings shall be of continuous machined or split-band type. Provide backing rings for joints 65 mm and larger.

d. Socket weld joints: UNI 7672.

2.2.7.2 Joints for Copper Tubing

a. Soldering [and brazing] metals: Solder, UNI EN 29453, tin-antimony alloy for service pressures up to 1034 kPa; brazing filler metal, UNI EN ISO 3677, with UNI, except or may be used for brazing copper-to-copper joints.

b. Provide mechanically formed joints only for making tees in existing system "K" or "L" type tubing. Adjoining tubing shall be brazed. Joints shall meet system design and test requirements specified herein, be approved by the manufacturer for the specific service, and be installed in strict accordance with the manufacturer's procedures and instructions.

2.2.8 Valves and Related Equipment

End connections shall conform to paragraph entitled "End Connections." Valves shall have rising stems and shall open when turned counterclockwise.

2.2.8.1 Gate, Valves

a. Bronze gate valves, 50 mm and smaller: UNI ISO 5781, wedge disc, rising stem, inside threaded type. Provide solder-joint ends when used with copper tubing.

b. Steel gate valves: UNI 7125/FA 109, outside screw-and-yoke type with solid wedge or flexible wedge disc, with trim of heat and corrosion-resistant steel as recommended by the manufacturer for service indicated.

c. Cast iron gate valves, 65 mm and larger: UNI EN 1092-2, outside screw-and-yoke type with bronze trim.

2.2.8.2 Globe and Angle Valves

a. Bronze, 50 mm and smaller: UNI ISO 5781, with renewable seats and discs except internal slats for solder-end valves.

b. Steel: UNI 7125/FA 109, with heat and corrosion-resistant trim as recommended by the manufacturer for service indicated, and provided with tapped drains and brass plugs.

c. Cast Iron, 65 mm and larger: UNI EN 1092-2, with bronze trim, tapped drains, and brass plugs.

2.2.8.3 Check Valves

a. Bronze, 50 mm and smaller: UNI ISO 5781, regrinding-swing-check type.

b. Steel, 65 mm and above: UNI 7125/FA 109, with heat and corrosion-resistant trim as recommended by the manufacturer for conditions indicated.

c. Swing check valves: Provide with bolted caps.

d. Lift check valves, 50 mm and smaller: Provide with bolted caps.

e. Cast iron check valves, 65 mm and larger: UNI EN 1074-3, with bronze trim.

2.2.8.4 Water Temperature Mixing Valves

UNI 9497.

2.2.8.5 Water Pressure-Reducing Valves

UNI 9753.

2.2.8.6 Plug Valves

Cast iron or steel, Size 50 mm and larger, [Flanged] [Threaded] End Connection. Replaceable valve seat is not required.

2.2.8.7 Ball Valves

UNI EN 331; copper alloy; valve design which permits inspection and repair of seats and seals without removing valve body from line; End Connection [threaded.] [soldered.] [welding ends.] [Flanged ball valve shall conform to UNI 8858, [bronze] [steel].]

2.2.8.8 Drain Valves

Gate valves conforming to UNI ISO 5781, manually operated 20 mm pipe size and above, with threaded ends. Provide hose nipple adapters for connecting a hose to lead to a convenient floor drain. [Provide frost-free valves for installations exposed to weather.]

2.2.8.9 Air Vent Valves

[Manually-Operated General Service Type] [and] [Automatic Type. Automatic-type air vent valves (Water Traps) shall be of ball-float type. Provide valves with brass/bronze or brass bodies, 300 series corrosion-resistant steel float, linkage and removable seat of hardened, corrosion-resistant steel.] Air vent valves on water coils shall have not less than 3 mm threaded end connections. Provide 20 mm pipe size for water mains and 15 mm minimum pipe size for other applications.

2.2.8.10 Automatic Flow Control Valves

Individually selected and factory calibrated by the manufacturer for service specified. Valves shall automatically limit rate of flow of system to required design capacity regardless of system fluctuations. Valves shall regulate flow within 5 percent of their tag rating over an operating pressure differential of at least 10 times the minimum required for control. Provide tamperproof valves with body tappings suitable for connecting instruments for verifying flow control performance. Provide self-cleaning, cartridge-piston type with stainless steel, variable area orifices and stainless steel or nickel-plated pistons. Valves shall have bronze bodies with threaded, soldered, or flanged connections as required for pipe fittings. Furnish each automatic flow control valve with a valve kit located outside of insulation, and hose fittings suitable for use with measuring instruments as indicated.

When meeting component requirements herein, composite valves consisting of integral ball valve(s), automatic flow control valve, thermo wells, gage cocks, strainer, and fittings, or a combination thereof, are acceptable where certified by the manufacturer for specific service and installed in strict accordance with the manufacturer's recommendations.

2.2.8.11 Butterfly Valves

UNI 9760-1 tight shutoff valve, and valve ends shall be [flanged] [single flange (lug type)] [flangeless (wafer type)]. Valve body material shall be [cast iron] [steel] [bronze] and bubble tight for shutoff at design pressure. Flanged and flangeless valves shall have 300 series corrosion-resistant steel stems and discs or bronze discs with molded elastomer disc seals. Flow conditions shall be for regulation from maximum flow to complete shutoff by the throttling effect. Valves smaller than 200 mm shall have throttling handles. Valves 200 mm and larger shall have totally enclosed manual gear operators with adjustable balance return stops and indicators. Valves shall have a minimum of seven locking positions.

Butterfly valves 50 mm and smaller: One-piece and three-piece design with male or female [threaded] [soldered] end connections and shall be bubble tight for shutoff at rated operating pressure of valve. Provide 300 series corrosion resistant steel stem and disc assembly. Disc seal shall be suitable for liquid used in system in which valve is to be installed. Provide valves designed for throttling service use with valve lever and indicator adjustment.

2.2.8.12 Solenoid Valves

Provide direct acting or pilot operating type for use with liquid service. Valves shall conform to UNI 9497, and be designed for pressure drop required. Valves shall have seal-capped manual opening stems and be constructed for servicing without removing from line. Each valve shall include a coil housing, stem-and-plunger assembly nonmagnetic to the plug, stainless steel enclosing tube, seat-and-plunger, and proper inlet and outlet connections for installing into piping system. Direction of flow shall be indicated on body. Provide solenoid valves designed, manufactured, and tested specifically for the service in all respects, including material. Coil housing shall include a moistureproof coil in a metal housing with electrical wires extending through a female-pipe-tap-conduit connection. Coil shall be wired for electrical current used and be capable of withstanding temperature of liquid encountered plus heat from coil. Provide bodies, stems, and pistons of a material that will not corrode or pit when used in water systems. Valve with threaded connections shall conform to UNI ISO 7-1.

Type of valves: Direct operated valve shall be of the type that operates plunger by direct action of coil. Pilot operated valves shall be floating piston or direct-connected-plunger type. Pilot operated valve with floating piston shall be used on 15 mm or larger port size valves and capable of handling liquid temperature up to design temperature. Valves shall have flanged connections in sizes 40 mm and larger with companion flanges for either welding or soldering to piping. Sizes 32 mm and smaller may either have female thread connections or may be nonferrous with soldering connections.

2.2.8.13 Automatic Water Regulating Valves

For water cooled, halocarbon condenser service and controlled and operated by refrigerant pressure in condenser acting on a spring-balanced diaphragm or bellows, or condenser pressure controlled and operated by an electric or pneumatic operator. Control diaphragm shall be suitable for refrigerant in all respects including materials. Provide three way globe, straight through, or angle type[as indicated]. Valves shall have single seat with renewable composition discs with V-port skirts, tapered plugs or other means for providing the best control for the service. Valves up to and including 25 mm in size shall be brass or bronze, with [threaded,] [union] [flared] end connections. Valves 32 and 40 mm may be as specified for smaller sizes or of iron as specified for larger sizes. Valves 50 mm and larger shall be flanged iron bodies with brass or bronze trim. Provide corrosion-resistant material for valve and operating motor to preclude corrosion of working parts due to leakage of water from stem packing. Valves shall have direction of flow clearly and permanently indicated. Two-position valves not intended for modulating service shall have quick-opening plugs. Solenoid valves used in connection with water regulating valves shall be suitable for operation on control voltage used in system. Threaded pipe connections shall conform to UNI ISO 7-1.

2.2.8.14 Float Valves

Float valve shall be as recommended by valve manufacturer. Where float

rods are extended for tank applications, extension shall be properly supported and guided to avoid bending of float rod or stressing of valve pilot linkage.

2.2.8.15 Safety Relief Valves

Provide cast iron bodies conforming to ASTM A 126, Grade B with corrosion resistant internal working parts.

2.2.8.16 Balancing Valves

Balancing valves shall be calibrated bronze body balancing valves with integral ball valve and venturi or valve orifice and valve body pressure taps for flow measurement based on differential pressure readings. Valve pressure taps and meter connections shall have seals and built-in check valves with threaded connections for a portable meter. Meter shall be provided by the same manufacturer and be capable of reading system pressures and shall meet the requirements of the paragraph entitled "Flow Measuring Equipment." Valves shall have internal seals to prevent leakage around rotating element and be suitable for full shut-off at rated pressure. Valves shall have an operator with integral pointer and memory stop. Balancing valves shall be selected for the required flows as indicated on the plans.

2.2.9 Miscellaneous Components for Piping System

2.2.9.1 Strainers

[Screwed] [Flanged] connections, [860 kPa] [1720 kPa] gage pressure rating, [single] [duplex] basket type, with inlet and outlet on the same center line. Cast steel or fabricated steel body, [1000 by 1000] [[_____] by [_____]] mesh stainless steel baskets. Open area of one basket shall be 2.5 times inlet or outlet piping area. Furnish one spare basket for each location.

2.2.9.2 Flexible Hose

Provide water service type of seamless rubber tubing with molded nonferrous wire braid, or stainless steel bellows with stainless steel braid. Provide materials recommended by the manufacturer for use with [condenser cooling] [and] [chilled water.]

2.2.9.3 Flow Measuring Equipment

Orifice or venturi type. Flow metering equipment including pitot tubes, venturis, orifice plates, flanges, and indicating meters shall be the product of one and the same manufacturer. Provide flowmeters of [permanent type] [or] [portable type] [type indicated]. Flowmeters shall be suitable for service in which they are to be installed. Primary elements of flowmeters shall conform to UNI recommendations for flowmeters. Provide bronze, monel, or stainless steel materials for wetted parts of flow meters.

a. Orifices: Square-edge type, made of corrosion and erosion resistant metal and mounted between pipe flanges having

factory-made pressure taps provided with shutoff valves. Orifice flanges shall conform to UNI EN ISO 5167-1/A1.

b. Tubular flowmeters: Flow measuring elements consisting of venturi tubes or pitot tubes where indicated. Locations and arrangement of piping, both upstream and downstream of flow measuring elements shall conform to the manufacturer's published literature. Provide each flow measuring element with an integral tab, or a metal tag on a corrosion-resistant steel wire, extending outside pipe covering, and stamped or printed in a visible position with manufacturer's name and address; serial number of meter to which it is to be connected; name, number, or location of equipment served; specified rate of flow; and multiplier to be applied to meter reading. Provide taps with shutoff valves and quick connecting hose fittings for portable meters or double ferrule compression fittings for connection to tubing for permanently located meters or recorders. Tubes shall be calibrated in accordance with UNI recommendations.

(1) Venturi tubes: Certified by the manufacturer for the actual piping configuration and any necessary piping changes required for certification without additional cost to the Government. Throat diameter for each venturi tube shall be designed so that at specified rate of flow the scale reading will fall between 50 percent and 80 percent of full scale value. Select venturi tube sizes from the manufacturer's latest published tables of flow versus differential pressure. Unrecovered head loss at maximum flow shall not exceed 10 percent. Provide bronze or cast iron tubes with bronze-lined throats, with flanged, threaded, or welded ends to suit piping system. Provide bodies of fabricated steel and fittings of the same class as piping in which installed. Two integral meter taps shall be provided in each venturi tube. Connections for attachment to portable flow meter hoses shall be readily accessible and not over 1.83 meters above a floor or permanent platform.

(2) Pitot tube assemblies: Provide corrosion-resistant materials. Tubes shall be capable of measuring liquid flow through tube elements providing an averaged, interpolated flow measurement from a single, fixed position. Provide self cleaning elements and impact tube designed to rotate when turned by the operator to protect pressure-sensing elements of tube when not in use. Location and total amount of pitot tubes required for system flow measurement shall be as recommended by the manufacturer and as indicated.

c. Meters: Designed for a full scale pressure differential of 12.5 kPa gage for tubular type or 25 kPa (gage) gage for orifice type. Dials shall have square root or linear scales with developed length of not less than 305 mm. Provide flush mounted panel meters that read directly in cubic meter per second. Dials of portable meters shall have square root scales reading from 0 to 6 liter per second for use with multiplier stamped on orifice or tubular type. Provide meters designed for not less than 1379 kPa

and protected against pressure surges. Meter bodies shall have taps for venting and draining.

(1) Permanently mounted meters: Each meter shall be connected completely [as indicated] [and] [as specified] and provided with the following: three valve manifold equalizer lines, two block valves, two vent and drain valves, and an integral pulsation damper. Overall accuracy of meters shall be plus or minus 2 percent of full scale flow over a range from 20 to 100 percent of full scale flow.

(2) Portable meters: Provide meter with a factory-fabricated carrying case with carrying handle. Provide case fitted to hold meter securely and to accommodate the following accessories:

(a) Two 4.50 meters lengths of connecting hose with suitable female connectors for connecting from meter to [venturi tube] [orifice flange] [pitot tube] pressure-tap nipples. Provide hose designed for a minimum service pressure of 862 kPa or 150 percent of maximum system service pressure, whichever is greater.

(b) A completely assembled three-valve manifold with two block valves and vent and drain valves, piped and mounted on a base designed for use laying flat on a stationary surface.

(c) A bound set of descriptive bulletins, installation and operating instructions, parts list, and a set of curves showing flow versus pressure differential for each orifice, venturi tube, or pitot tube with which meter is to be used.

(d) A metal instruction plate, secured inside cover, illustrating use of meter.

(e) Provide meters with overall accuracy of plus or minus 5 percent of full scale flow over a range from 20 to 100 percent of full scale flow.

2.2.9.4 Pipe Hangers and Supports

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NOTE: When the project specification does not have a section for insulation of mechanical systems, include requirements of Section 15080 for metal protection shields and inserts for insulated piping in this section.

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Design and fabrication of pipe hangers, supports, and welding attachments shall conform to UNI 9760-1. Hanger types and supports for bare and covered pipes shall conform to UNI 9760-1 for system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to UNI 9760-1. Provide metal protection shields and inserts for insulated piping in accordance with Section 15080, "Mechanical Insulation."

2.2.9.5 Pipe Guides

Provide [spider type] [cylindrical type] [or] [hold-down slide type] utilizing factory-bonded graphite, teflon, or oil-impregnated metal matched surfaces.

2.2.9.6 Pipe Sleeves

Pipe sleeves penetrating outside walls, floors, and roof slabs shall be zinc-coated steel pipe conforming to UNI 663, UNI 1282, and UNI 1288. Sleeves penetrating inside partitions shall be zinc-coated sheet steel not less than 0.51 mm thick, conforming to UNI EN ISO 1461.

2.2.9.7 Condensate Drains

UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5, hard drawn with UNI EN 1254-1, UNI EN 1254-2, UNI EN 1254-3, UNI EN 1254-4/AC, and UNI EN 1254-5 fittings.

2.2.9.8 Cooling Coil Drain Pans

[Steel, Series 300 corrosion-resistant] [Galvanized steel], [double] [single] pan(s).

2.2.10 Pumps

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NOTE: Base pump selection upon the particular service and system requirements. Horizontal (axially) split-case double suction type pumps operating at not over 1800 RPM, or pumps as specified below, are acceptable. The following is provided as a guide only.

Discharge Pipe Connections (Nominal Pipe Size)	Meter	Pump Type	Max. Pump Speed RPM
200 mm and smaller	38 (Max.)	Vertical (radially) split	1800
100 mm and smaller	30 - 60	Vertical (radially) split	3600
80 mm and smaller	18 (Max.)	(a) Vertical (radially) split, single-suction	1800
		(b) Close couple	1800
80 mm and smaller	Above 18	(a) Vertical (radially) split, single-suction	1800
		(b) Close couple	1800

Discharge Pipe Connections (Nominal Pipe Size)	Meter	Total Dynamic Head Pump Type	Max. Pump Speed RPM
8" and smaller	125 (Max.)	Vertical (radially) split	1800
4" and smaller	100 - 200	Vertical (radially) split	3600
3" and smaller	60 (Max.)	(a) Vertical (radially) split, single-suction	1800
		(b) Close couple	1800
3" and smaller	Above 60	(a) Vertical (radially) split, single-suction	1800
		(b) Close couple	1800

****

Horizontal centrifugal water pumps for [dual service] [chilled water], [and] [condenser] water systems shall conform to UNI EN 809, and shall have replaceable mechanical seals of material and style recommended by the manufacture for the particular service. End suction pump shall have vertical (radially) split casing. Pumps shall have [single] [double] suction with [volute] [or] [diffuser] water passage. Impellers shall have [radial] [or] [mixed] flow. Select pumps so that the operating point on selected impeller-curve will lie at or to left of shutoff side of, and not more than 5 percent below, point of maximum efficiency for impeller. [Vertical or horizontal, inline circulator pumps for forced hot water heating systems shall conform to UNI EN 255-3.]

2.2.10.1 Pump Motors

Motors shall conform to CEI EN 60034-1 and be suitable for electrical characteristics as indicated. Provide [open] [splash proof] [totally enclosed] type.

2.2.10.2 Motor Starters

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NOTE: Motor control requirements should be coordinated with Electrical Section and will depend on field conditions. The following types of motor starters should be used as a guide only. When electrical power circuits to which air conditioning units are connected are heavily loaded, full voltage-across line starting may result in excessive voltage drop on circuit.

Motor kW	Voltage	Type Starter
Up to 5.50	208-230	Across line magnetic

Motor kW	Voltage	Type Starter
5.50 to 11	208-230	Across line magnetic, part wind or wye delta

Motor H.P.	Voltage	Type Starter
Up to 7 1/2	208-230	Across line magnetic
7 1/2 to 15	208-230	Across line magnetic, part wind or wye delta

****

CEI EN 60947-4-1 [manual] [across the line] [reduced-voltage-start] [part-wind] [wye-delta] type with CEI EN 60529/A1 [general purpose] [weather-resistant] [watertight] enclosure.

2.2.11 Tanks

2.2.11.1 Expansion Tank

Provide welded steel tank constructed and tested hydrostatically in accordance with UNI 7182, and UNI 7183. Minimum design pressure of tank shall be as specified. Tank shall be zinc-coated inside and out after fabrication by UNI EN ISO 1460 hot-dip process. Tank shall have drain, fill, air charging and system connections.

2.2.11.2 External Air Separation Tank

Provide steel tank, designed and constructed in accordance with UNI 7182 and UNI 7183, factory-tested and UNI-labeled for design pressure specified. Capacity of separator shall not be less than indicated. Tank shall have tangential connections, flanged for sizes 65 mm and larger and threaded connections for 50 mm and smaller inlets and outlets. Each unit shall have an internal design suitable for creating required vortex and subsequent air separation, for air release to [system expansion tank] [atmosphere] [vent] and shall also have a galvanized steel strainer. Provide a blow-down connection with a gate valve piped to nearest floor drain.

2.2.12 Instrumentation

Provide scale range based upon location, application, and design pressure as indicated or specified.

2.2.12.1 Pressure and Vacuum Gages

Dial Type, elastic element, UNI 9765 with integrally mounted restrictor, dial size 114 or 150 mm; positive, vacuum, compound, or differential pressure type as indicated.

2.2.12.2 Tank Gages

Tank gages, liquid measuring level shall be in accordance with tank

manufacturer recommendations.

2.2.12.3 Indicating Thermometers

Thermometers shall be dial type with an adjustable angle suitable for the service. Provide thermowell sized for each thermometer in accordance with the thermowell specification. Fluid-filled thermometers (mercury is not acceptable) shall have a nominal scale diameter of 125 mm. Construction shall be stainless-steel case with molded glass cover, stainless-steel stem and bulb. Stem shall be straight, length as required to fit well. Bimetal thermometers shall have a scale diameter of 90 mm. Case shall be hermetic. Case and stem shall be constructed of stainless steel. Bimetal stem shall be straight and of a length as required to fit the well.

a. Chilled Water: Dual scale with range of minus 40 to plus 50 degrees Celsius in one degree divisions.

b. Hot Water: Dual scale with range of plus 10 to plus 150 degrees Celsius in 2 degree divisions.

2.2.12.4 Remote Reading Thermometers

Separable well type with insertion length and sensing portion length of well and socket suitable for piping and service intended.

2.2.12.5 Pressure/Temperature Test Ports

Pressure/Temperature Test ports shall have brass body and EPDM and/or Neoprene valve seals. Ports shall be rated for service between 2 and 135 degrees C and up to 3447 kPa (gage). Ports shall be provided in lengths appropriate for the insulation thickness specified in Section 15080, "Mechanical Insulation" and installed to allow a minimum of 305 mm of access for probe insertion. Provide with screw-on cap attached with a strap or chain to prevent loss when removed. Ports shall be 8 mm DN and accept 3 mm diameter probes.

2.2.13 Expansion Joints

2.2.13.1 Guided Slip Tube Expansion Joints

UNI 7151, internally-externally guided, injected semiplastic packing, with service outlets, UNI 2249, UNI 2250, and UNI 2253 flanged end connections. Provide single or double slip tube type as indicated.

2.2.13.2 Flexible Ball Expansion Joints

Carbon steel with polished steel balls capable of 360 degrees rotation plus 15 degrees angular flex movement, UNI 2249, UNI 2250, and UNI 2253 flanged end connections. Provide pressure-molded composition gaskets suitable for continuous operation at twice design temperature.

2.2.13.3 Bellows Expansion Joints

UNI EN 1514-4, stainless steel corrugated bellows, reinforced with

equalizing rings, internal sleeves, external protective covers, and UNI 2249, UNI 2250, and UNI 2253 flanged end connections. Joints shall be designed to withstand 10,000 cycles over a period of 20 years.

2.2.14 Backflow Preventers

Reduced pressure principle type conforming to applicable requirements of UNI 9157.

2.3 WATER TREATMENT SYSTEMS

Capable of automatically feeding chemicals to prevent scale and corrosion and biological growths. Systems shall include chemical feed pump, tank and electric timer. Provide a polyethylene tank and injection valve assembly for each feed pump.

2.3.1 Tanks

Construct of high density polyethylene, cylindrical in shape, and with a hinged cover.

2.3.2 Pumps

Provide electronic diaphragm chemical feed pump(s) with polypropylene head, 220 VAC, 50 Hz, electronic stroke control, anti-syphon/pressure relief valve assembly, foot valve assembly, injection/check valve assembly, chemically compatible suction and discharge tubing, and ceramic suction line weight. Chemical pump(s) shall be capable of injecting chemicals against pressure and properly sized for system requirements.

2.3.3 Corporation Stop

Provide corporation stop and injection assembly with 13 mm CPVC injection nozzle, 19 mm NPT male connection and back check valve for injecting chemicals into recirculating line. A corporation stop shall be used for each chemical that is introduced into the recirculating line by a feed pump.

2.3.4 Pretreatment

All hot water or chilled water piping and related equipment shall be thoroughly flushed out with cleaning chemicals designed to remove deposits from construction, such as, pipe dope, oils and loose mill scale.

2.3.5 Chemicals

Provide chemicals for the control of corrosion and microbiological fouling based on an analysis of the system materials of construction and make up water. The chemical shall be provided in quantities sufficient for startup and one year of operation. Chemicals shall have no detrimental effects on the materials in the systems. No chromium, zinc, or other heavy metal will be permitted.

2.3.6 Testing Equipment

Provide equipment and reagents to verify the concentration of corrosion inhibitor.

2.3.7 Timers

Automatic reset, adjustable type, and electrically operated. House in metal type cabinet with a hinged front. Timers shall be suitable for 120 volt current.

2.3.8 Sequence of Operation

2.3.8.1 Timers

Provide to turn feed pumps on for a pre-set amount of time.

2.3.9 Piping

Provide plastic piping and fittings conforming to ASTM D 2996 for water treatment system. Piping for feed pump suction shall contain a foot valve and strainer.

2.3.10 Water Analysis

Provide make-up water analysis in accordance with Italian laws and regulations methods and tests. Analysis shall include test results for the following:

Description

Silica (Si02)
Insoluble
Iron and Aluminum Oxides
Calcium (Ca)
Magnesium (Mg)
Sodium and Potassium (Na and K)
Carbonate (CO3)
Bicarbonate (HC03)
Sulfate (S04)
Chloride (C1)
Nitrate (N03)
Turbidity
pH
Residual Chlorine
Total Alkalinity
Noncarbonate Hardness
Total Hardness
Dissolve Solids
Fluorine
Conductivity

2.3.11 Pipe Cleaning Chemical

Provide surfactant/copolymer/phosphate compound in solution form. Furnish accessories necessary to mix and charge into system. Provide chemical

cleaning of both hot and chilled water piping.

2.3.12 Pipe Cleaning Accessories

Provide temporary piping loops, temporary circulating pump, caps and blind flanges to permit pipe cleaning.

PART 3 EXECUTION

3.1 INSTALLATION

Install piping and piping components to ensure proper and efficient operation of equipment, and controls and in accordance with manufacturer's printed instructions. Provide proper supports for mounting of vibration isolators, stands, guides, anchors, clamps and brackets. Arrange piping connections to equipment so that removal of equipment or components of equipment including tube withdrawal from chillers, pump casing, shaft seals and similar work can be accomplished with the least amount of disassembly or removal of piping system. Provide piping connected to equipment with vibration isolators with flexible connections which shall conform to vibration and sound isolation requirements for system. Electric isolation shall be provided between dissimilar metals to reduce rate of galvanic corrosion.

3.1.1 Water Piping

UNI EN 545.

3.2 PIPING SYSTEMS

Cut to measurements established at site and work into place without springing or forcing. Install piping with line flexibility included to absorb expansion and contraction due to temperature changes of piping systems. Piping line flexibility shall be achieved by use of [pipe bends or loops] [or] [bellows-type expansion joints] [and] [or] [slip-type expansion joints] [flexible ball-type expansion joints]. [Bellows-type expansion joints: Provide limit stops to limit total movement in both directions. Cold set joints to compensate for temperature at time of installation. Provide [single] [or] [double] bellows expansion joint [as indicated]. Provide first pipe alignment guide no more than 4 pipe diameters from expansion joint; provide second pipe alignment guide no more than 14 pipe diameters from first guide.]

3.2.1 Flanged Joints

Faced true, square, tight and provided [as indicated] [and] where necessary for normal maintenance. Mate with valves and various equipment connections. Remove raised faces when used with flanges having a flat face.

3.2.2 Threaded Joints

Clean threads and apply suitable amount of teflon tape or teflon pipe dope prior to making joint.

3.2.3 Pipe Bends

Acceptable in lieu of pipe fittings where space permits. Pipe bends shall have a uniform radius of at least five times the nominal pipe diameter. Pipe bends shall be free of any flattening, wrinkling, or thinning of pipe walls other than minor external surface distortions. In occupied space pipe bend radii shall not exceed five times the nominal pipe diameter.

3.2.3.1 Copper Tubing

Pipe bends for annealed copper tubing in lieu of fittings may be provided where space permits. Bends for annealed copper tubing shall conform to UNI 7773-1. Tubing bends shall be free of any appreciable flattening, wrinkling, or thinning of tubing walls.

3.2.4 Reducing Fittings

Provide to connect changes of sizes in piping lines. Make branch connections with tees [except that factory-made-forged-steel welding branch outlets or nozzles having integral reinforcements may be provided when the nominal diameter of piping system branch does not exceed one nominal pipe size less than nominal size of piping segment containing fitting].

3.2.5 Insulation

Piping insulation [shall be in accordance with Section 15080, "Mechanical Insulation"] [and] [shall be as indicated] [and] with enough clearance allowed between pipes to permit application of insulation.

3.2.6 Brazing and Soldering

Preparation and procedures for soldering and brazing of joints shall conform to UNI EN ISO 10564 and shall be in accordance with the procedure as outlined in UNI 7773-1.

3.2.7 Dielectric Unions or Flanges

Provide between ferrous and nonferrous piping, equipment, and fittings; except that bronze valves and fittings may be provided without dielectric couplings for ferrous-to-ferrous or nonferrous-to- nonferrous connections. Flanges and unions shall conform to requirements of UNI EN 1092-2.

3.2.8 Pipe Hangers and Supports

Installation including spacing shall conform to UNI 9760-1.

3.2.9 Pipe Guides

Protect and clean teflon or oil-impregnated matched surfaces prior to start-up.

3.2.10 Flexible Connections

Install flexible pipe connectors on piping connected to equipment.

Flexible section shall consist of rubber, tetrafluoroethylene resin, corrosion-resistant steel, bronze, monel, or galvanized steel. Material provided and configuration shall be suitable for [pressure,] [vacuum,] [temperature,] and circulating medium. Flexible section shall have [threaded,] [welding,] [soldering,] [flanged] [or] [socket-weld] ends and shall be suitable for service intended. Flexible section may be reinforced with metal retaining rings, with built-in braided wire reinforcement and restriction bolts or with wire braid cover suitable for service intended.

3.2.11 Pipe Sleeves

Provide pipe sleeves for pipes and tubing which penetrate building structure. Securely retain sleeves in position and location before and during construction. Space between pipe and sleeves, or between insulation of pipe and sleeves, shall be not less than 6 mm between outside of pipe or insulation, and inside wall of sleeves. Pack annular space with hemp or fiberglass, and seal with elastic cement. Sleeves for uninsulated pipes shall have ends flush with finished wall surfaces and pipe or tubing with outside perimeter of pipe calked to sleeve. Sleeves for insulated pipes shall extend 15 mm from concrete or masonry ceiling or wall faces and outside perimeter of insulation shall be caulked to sleeve on both sides of faces. Seal terminal ends of pipe insulation with mastic. Sleeves for lines passing through floors shall extend 75 mm above finished floor slab, and be calked to the slab. Equip lines passing through exterior walls and roof areas with flashing and counter flashing [as indicated] [or] [as approved] to form a watertight roof seal [and shall conform to Section _____, "_____"].

3.3 WATER PIPING

[Chilled Water,] [Condenser Water,] [and] [Hot and Cold Water (Dual Service)] Piping.

3.3.1 Fabrication and Assembly of Piping and Components

Welding, heating, and soldering shall conform to UNI EN ISO 10564 and as specified herein. [Horizontal runs of piping shall pitch toward water chiller at not less than 25 mm in 6 meters.] Provide sufficient pitch to assure adequate drainage and venting. Drain valves at low points of piping system, and automatic air vent valves at high points where air pockets would occur. Piping shall follow general arrangement shown, cut accurately to measurements established for the work by the Contractor, and worked into place without springing or forcing, except where cold-springing is indicated. Piping and equipment within buildings shall be entirely out of the way of electrical conduit, lighting fixtures, equipment and doors, windows, and other openings. Run overhead piping in buildings in the most inconspicuous positions. Provide adequate clearance from walls, ceilings, and floors to permit welding of joints; at least 152 mm for pipe sizes 100 mm and less, 254 mm for pipe sizes over 100 mm, and in corners provide sufficient clearance to permit the welder to work between pipe and one wall. Provide for expansion and contraction of pipe lines. Make changes in size of water lines with reducing fittings. Do not bury, conceal, or insulate piping until inspected, tested, and approved. Protect materials and equipment from weather. Run pipe to be insulated as

shown and as required with sufficient clearance to permit application of insulation. Do not miter pipe to form elbows, or notch straight runs to form full-sized tees, or utilize any similar construction. Except where shown otherwise, run vertical piping plumb and straight and parallel to walls. Thoroughly clean each section of pipe, fittings, and valves to be free of foreign matter before erection. Prior to erection, hold each piece of pipe in an inclined position and thoroughly tap to loosen sand, mill scale, and foreign matter. Before final connections are made to apparatus, wash interior of piping thoroughly with water. Blow out piping with high pressure steam or compressed air to remove rust scale, oil, and debris. Plug or cap open ends of mains during shutdown periods. Do not leave lines open at any place where foreign matter might accidentally enter.

3.3.1.1 Insulation of Copper Tubing

Insulate copper tubing placed in cinder fill or run through cinder block foundation from cinder material to prevent sulphur corrosion by wrapping complete continuous tubing surface with protective tape.

3.3.1.2 Strainers

Provide strainers in [chilled water] [and] [condenser water] lines to protect orifices, automatic valves, pump and compressor from foreign materials. Locate strainers close to equipment to be protected. Install strainers with screen drum and in direction of flow, as marked on strainer body. Strainers shall have isolating service valves to permit servicing strainer with minimum loss of fluid. Provide clearance for removal and replacing of strainer screens. Strainers shall have screens of ample net free area and be composed of materials which shall be compatible with fluid being used. Provide reducer fittings for changes in pipeline sizes and strainer connection sizes. Provide a pressure gage with valved connection to inlet and outlet sides of strainer for determining pressure drop through strainer, for indicating need for cleaning strainer screen.

3.3.1.3 Shell and Tube Vessels and Clearance

Provide shutoff valves in water lines to vessels to permit servicing without draining system. Locate valves so as not to interfere with head removal. Where water boxes are provided, water piping connections may be made directly to covers. Provide piping with mechanical piping connections adjacent to covers, and water shutoff valves located so as not to interfere with tube cleaning or pulling operations after pipe sections have been removed. Maintain working space for removal of heads, and on one end of vessel provide a clear space at least equal to overall length, breadth, and depth of the tube bundle for tube removal. A door opening, window, or wall opening, may be utilized for this purpose.

3.3.1.4 Piping, Chilled Water Coils

Provide chilled water coils with a counterflow piping arrangement. Connect supply piping at bottom of coil and connect return piping at top of coil. Provide supply piping to coil connection with gate valve, strainer, thermometer-bypass tee for valve bypass when three way valve is provided, tee with nipple, globe valve with hose connection, and union in that order.

In lieu of orifice with manometer connections and [plug valve] or [ball valve] a calibrated balancing valve may be provided for balancing the water flow. Provide return piping from coil connection with a union, tee with nipple, globe valve with hose connection, air chamber and vent at high point, thermometer, automatic control valve and bypass, when required, orifice with manometer connections, [plug valve] [or] [ball valve] for balancing, and gate valve, in that order. Provide lengths of straight, uninterrupted pipe before and after orifice flanges, as required by the orifice manufacturer. Provide [plug valve] [or] [ball valve] for balancing in three-way valve by-pass piping when included as part of system. Provide unions and flanges as necessary to permit removal of coil and automatic control valves. Piping and fittings shall not interfere with access to equipment. For multi-coil arrangement, provide each supply and return line to and from coil with a union, thermometer well, and [plug valve] [or] [ball valve] for balancing.

3.3.1.5 Pumps

Support, anchor, and guide so that no strains are imposed on pump by weight or thermal movement of piping. Provide air vent valve on pump casing. Pipe drain outlets on pump bases to nearest floor or other acceptable drains, with necessary clean-out tees. Provide pig tails or pet cocks for pressure gages on suction and discharge for water balancing measurements.

3.3.1.6 Valves

Install at equipment to allow maintenance or isolation, and to establish proper and sequential operation of complete system. Shell and tube liquid coolers shall have fluid valves installed so that tubes are accessible for cleaning or replacing. Provide globe valves or plug cocks where required to regulate flow to obtain equal distribution of gas or fluid handled. Remove valve bonnets, where valve construction permits removal, when connecting valves by brazing to copper tubing. Install globe and angle valves with stems as close to vertical as possible and in no case lower than horizontal to avoid trapping of fluid.

3.3.1.7 Air Vent Valves

Provide at high points in water piping and at water coils and water heat exchangers. Provide isolation valves and pipe to run off into the nearest floor drain.

3.3.1.8 Orifice Flanges

Provide in the main [chilled water] [and] [condensing water] piping, [and] [chilled water coils]. Provide orifice flange conforming to UNI EN ISO 5167-1/A1, with tapped openings and pipe extensions with shutoff valves. Provide venturi or pitot flow tubes in lieu of orifice plates. Provide each orifice plate, venturi tube or pitot tube, with an integral tab, or a tag on a chain, extending outside pipe covering on which shall be stamped or printed in a plainly visible position the manufacturer's name and address, serial number of meter to which it is to be connected, name or number of equipment served or its location, specified rate of flow and multiplier, if any, to be applied to meter reading. Specified rate of flow

will be that of connected pump and cooling coil or as indicated. Select venturi tube, pitot tube, or orifice sizes from the manufacturer's latest published flow versus differential pressure tables.

3.3.1.9 Automatic Flow Control Valve

When necessary, increase system pump head to obtain proper operating differential between body tappings for control of maximum flow; minimum allowance 14 kPa, maximum allowance 21 kPa. Verify correct flow by establishing that operating pressure differential across valve tappings is within tag range. Pressure measuring apparatus shall be portable and consist of a carrying case, instructions, hoses and connections, and a push-button, three way valve which transmits either of two pressures to a pressure gage. Pressure gage shall have a 115 mm minimum diameter dial calibrated in increments of 5 kPa or less, and shall have a range of minus 101 kPa to design pressure. Where flow-rate-pressure differential is marginal or deficient, use a portable flowmeter to verify flow rate, when requested by the Contracting Officer.

3.3.1.10 Automatic Water Regulating Valves

When indicated, install a solenoid valve upstream of the regulating valve to completely open or completely shutoff water supply when compressor starts and stops. Solenoid valves will not be required on cooling tower lines running from automatic water regulating valve. Regulating valve shall limit flow of cooling water to actual requirements of system load. Size valves so that head loss at maximum flow will not exceed that of 3 running meters of pipe or half the head loss through condenser, whichever is greater. Install a three-way automatic regulating valve with common outlet piped to cooling tower, bypass piped to one inlet and condenser water outlet to other inlet. Common outlet shall have balancing cocks provided in upstream piping for required equal pressure adjustment.

3.3.1.11 Closed Expansion Tank

Provide automatic water makeup, and automatic relief to drain with air gap between relief outlet and drain. Pneumatically pressurize tank during charging of water, so that system is fully charged with water and with level in expansion tank at normal level at normal operating conditions.

3.3.1.12 Instrumentation

Locate gages and thermometers as indicated.

a. Pressure and vacuum gage: Provide a shutoff valve or pet cock between pressure gages and pipe line.

b. Thermometers: Provide thermometers and thermal sensing elements of control valves with a separate socket. Install separable sockets in pipe lines in such a manner to sense temperature of flowing fluid and minimize obstruction to flow.

3.4 MISCELLANEOUS DRAINS

3.4.1 Condensate Drains

Provide drain piping from cooling coils to drain condensate. Trap drains at exit point of cooling coil and connect to area drain system, in accordance with UNI 9182.

3.4.2 Cooling Coil Drain Pans

Provide drain connections and lines to remove condensate collected on cold coil surface from air stream. Pipe condensate from drain pan bottom to a disposal point outside of coil casings and trap to ensure complete pan drainage. Provide double drain pans where possible.

3.5 MISCELLANEOUS PIPING

3.5.1 Make-up Water Piping

Provide make-up water piping to water control float assembly of [evaporative condensers] [and] [cooling towers], [expansion tanks]. Protect potable water system at cross-connection to make-up water piping by a backflow preventer of type specified in paragraph entitled "Backflow Preventers."

3.5.2 Drain and Overflow Piping

Provide drain and overflow piping for [cooling towers] [evaporative condensers] [evaporative coolers]. Connect drain piping to area drain system.

3.5.3 Water Bleedoff Piping

Provide a constant restricted water bleedoff during operation of [cooling tower] [evaporative condenser] [evaporative coolers] by means of a bleed connection in pump discharge with a regrinding type globe valve, or interchangeable type orifice so that bleed quantity may be set for local water conditions, to prevent accumulation of undesirable concentration of salts and acids. Route bleedoff piping to nearest area drain system [or as indicated.]

3.5.4 Cooling Towers and Evaporative Condensers

Roof installations, where ambient temperature is seasonally below freezing, shall have basin overflow connected to basin drain, and drain line shall immediately enter the building where it is not subjected to freezing, in route to drain sewer. Towers and condensers at grade level shall have overflow and drain similarly connected, and drain shall then run underground to nearest available drain sewer. Towers and condensers installed on a roof area, and where ambient temperature does not subject them to freezing, may drain on roof, when rain water conductors are of ample size to accept flow when draining.

3.6 ELECTRICAL EQUIPMENT

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NOTE: Where applicable, provide sensors for tie-in to Energy Monitoring Control System including testing of sensor points. This should be coordinated with the applicable NFGS-EMCS section where used.

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[Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for motor control specified.]

3.7 WATER CHEMICAL TREATMENT

3.7.1 Supervision

Provide the services of an authorized representative of the water treatment supplier to supervise the installation, operational check out and startup of the water treatment system.

3.7.2 Equipment Placement and Mounting

The equipment and devices shall be located essentially as shown on the drawings; however, actual placement shall be verified using field measurements, installation diagrams and data relating to the equipment actually approved for installation on this project. The equipment, including accessory devices, shall be mounted in strict accordance with the water treatment supplier's instructions.

3.7.3 Operating Instruction

The contractor shall include in his price the services of an authorized representative of the water treatment supplier to provide on site operating and service instructions to the Owner's designated operating personnel.

3.7.4 Service

The water treatment supplier shall provide service for one year, conducting at least one service call every twelve weeks and providing to the Owner at the time of the service call a written report which includes water analysis and recommendations. At the completion of the year's service, water samples from each independent closed loop water system will be submitted to the water treatment company's laboratory, and a written report of the findings will be provided to the Owner.

3.7.5 Chemical Parameters

Provide chemicals in quantities sufficient to maintain water at the following parameters:

PH: 8.5 to 10.5
Conductivity: Less than 5000 us/cm.
Total hardness: Less than 0.5 F.
Total alkalinity: Less than 1000 PPM CaC03.
Total bacteria: Less than 10/3 col/ml.

Chloride: Less than 800.
Insoluble iron: Less than 0.03 PPM Fe +2
Turbidity: Less than 20 FAC.
Corrosion: Less than 5 mpy.

3.8 CLEANING OF SYSTEMS

When installations of various components of piping systems are completed, clean before final closing. Clean piping and components of scale and thoroughly flush out foreign matter. Provide temporary bypasses for water coils to prevent flushing water from passing through coils. Clean strainers and valves thoroughly. Wipe equipment clean, removing traces of oil, dust, dirt, or paint spots. Maintain system in this clean condition until final approval. Clean and paint piping and equipment.

3.8.1 Safety Procedure

Ventilate work area, avoiding skin contact by using solvent-resistant gloves. Observe precautions and warnings on the manufacturer's product labels.

3.9 IDENTIFICATION OF PIPING AND PHYSICAL HAZARDS

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NOTE: When the project specification does not have a painting section, include requirements in Section 09900, "Paints and Coatings" for cleaning and painting of piping and equipment, and stencilling of piping in this section.
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Identify piping and physical hazards in accordance with UNI 7543-1 and ANSI A13.1. Spacing of identification marks on runs shall not exceed 15 meters. Painting and stencilling shall conform to Section 09900, "Paints and Coatings." Colors shall conform to UNI 7543-1. Tag equipment, gages, thermometers, valves, and controllers with tags of brass or approvable nonferrous material and securely mount or attach.

3.10 FIELD INSPECTIONS

Prior to initial operation examine and inspect piping system[s] for conformance to plans and specifications. Equipment, material, or work rejected because of defects or nonconformance with plans, specifications, and CTI (Italian Thermotechnical Committee) Codes for pressure piping shall be corrected as directed by the Contracting Officer.

3.11 FIELD TESTS

After completion of piping installation and prior to initial operation, conduct tests on piping system. Furnish materials and equipment required for tests. Correct defects disclosed by test. Perform test after installation and prior to acceptance in presence of the Contracting Officer and subject to his approval.

3.11.1 Water Piping

Test piping system at twice the design pressure with water not exceeding 38 degrees C. Before tests, remove or isolate gages, traps, and other apparatus in [new system] [existing piping system] which may be damaged. Repair leaks [tightening] [rewelding joints] [or] [renewing pipe or fittings]. Do not caulk joints. Install a calibrated, test pressure gage in system to observe loss in pressure. Maintain required test pressure for a sufficient amount of time to enable an inspection of joints and connections. Correct defects disclosed by test.

3.12 STARTUP AND OPERATIONAL TESTS

Start up and initially operate [chilled water] [and] [condenser water] system. During this time, periodically clean various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in required operation and sequence.

3.13 TESTING, ADJUSTING, AND BALANCING

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NOTE: Use the first sentence for simple hydronic systems and where Section 15950, "HVAC Testing/Adjusting/Balancing" is not included in the specification. Use the second sentence for all specifications with Section 15950.

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[Except as specified herein, perform in accordance with UNI ENV 1805-1 drawings and specifications; prepare complete report of final test results.] [Test, adjust and balance the hydronic system in accordance with Section 15950, "HVAC Testing/Adjusting/Balancing."]

-- End of Section --